Hyperventilation and Hypoventilation

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ONE OF THE underlying conditions of the organism that has important bearing on a person's outlook and self-feeling is the pattern of breathing he utilizes. Generally, however, we have not been trained to observe or understand the effects various breathing patterns have upon the personality. In this article I will briefly summarize some of the medical research that has been done with two breathing patterns, hyperventilation and hypoventilation.

As a beginning place, hyperventilation must be clearly differentiated from simple rapid breathing. Hyperventilation is the condition of breathing more than the metabolic balance of the body requires, a condition that changes the chemistry of the body and, therefore, its physiological functioning. A man running will breathe more rapidly than usual, but if he is exhaling carbon dioxide at the same rate that his muscles are excreting it, then he stays in metabolic balance and is not hyperventilating.

Similarly, hypoventilation must be distinguished from ordinary slow breathing. A person at rest, breathing quietly, may be in perfect metabolic balance, with his slow breathing in perfect harmony with his slow metabolic rate. Hypoventilation is the state of breathing too slowly for the body's needs, which will also produce important chemical changes. I will consider hyperventilation first, saving hypoventilation for the latter part of the article.

The major body gases involved in hyperventilation are oxygen and carbon dioxide. In a healthy person, the mechanism of oxygen transport and saturation is so efficient that blood leaving the lungs usually contains all the oxygen it can carry. Hyperventilation increases blood oxygen by only a very small, and generally unimportant, amount. The major effect of hyperventilation is upon the body's level of carbon dioxide.

The normal adult body contains 140 litres of carbon dioxide, most of it dissolved in bone and muscle, and there is a typical normal level of carbon dioxide in blood. One of the principle reactions of metabolism in the cells is the union of oxygen and sugar, which produces heat, energy and carbon dioxide as a waste by-product. The carbon dioxide is usually excreted through the lungs, and to some extent through the kidneys, at a rate that maintains the normal levels.

With hyperventilation, the carbon dioxide is breathed away faster than it is produced. The loss of carbon dioxide (which also occurs in the blood as carbonic acid) makes the blood less acid and more alkaline. This chemical change in the blood causes the arteries, which carry blood to the brain, to *constrict,* reducing the flow of blood to the brain to one-third of normal levels. This enormous decrease in cerebral circulation starves the brain of oxygen and sugar and disrupts normal cerebral functioning. While this has serious effects for normal people, the results are even more dramatic in those with low blood sugar or a predisposition to epilepsy.

The author, who is in excellent health, participated in the following experiment during a course in EEG. He reported to the laboratory early in the morning, having had a light supper and no breakfast. After the EEG electrodes were attached to the scalp, he then voluntarily hyperventilated very strongly for five minutes. The brain waves, which had previously shown a smooth, calm pattern of 10 cycle-per-second alpha waves, changed abruptly into a jumbled chaos of high-voltage irregular slow waves, appearing at the rate of two or three per second. The pattern was indistinguishable from a person with severe brain damage. The condition was completely cured by drinking a glass of orange juice with extra sugar and breath-holding for one minute.

What is important to emphasize is that hyperventilation does not increase oxygen supply to the brain, it decreases it.

As one might imagine, such severe changes in brain metabolism are reflected in subjective feelings. The following list contains the ten symptoms most commonly reported by a group of 150 Air Force recruits who were interviewed following an episode of hyperventilation. The most common symptoms are listed first: headache, dizziness, feeling short of breath, hands numb or tingling, dry mouth, feeling unsteady, feeling faint, feeling nauseated, having little stamina and tiring easily, and pain in the chest. This same group reported 20 additional symptoms, including feelings of unreality, senseless crying, senseless laughing and ringing in the ears.

Clinically, two major types of hyperventilation may be distinguished. The first is the acute type, usually associated with a sudden anxiety situation and characterized by visible, audible hyperventilation. The patient may look and sound like a steam locomotive. The other type is the picture seen with chronic ventilation. The patient does not appear to be overbreathing, and unless the observer is aware enough to notice an occasional deep sigh, the diagnosis may be missed entirely. Such patients may be in a state of depleted carbon dioxide for months or years on end, very often going from doctor to doctor, receiving a wide variety of psychiatric, cardiac and neurological diagnoses. An occasional deep sigh is sufficient to keep their carbon dioxide stores depleted.

A rich literature exists on chronic hyperventilation, which, before its nature was clarified, was variously labeled "Da Costa's Syndrome," "effort syndrome," "autonomic imbalance," "irritable heart," "soldier's heart," "cardiac neurosis," "functional heart disease," "clumsy circulation," and "psychoneurosis with cardiovascular symptoms."

Da Costa studied this problem extensively in Civil War soldiers, noting symptoms of fatigue, dizziness, chest pain, palpitations, headache, dimness of vision, rapid pulse, disturbed sleep and a sense of oppression in the chest. Following the First World War, thousands of soldiers were given medical pensions with different variants of this same syndrome, and studies of their condition continued to be published until 1940. One author of that era described the usual patient's complaint as a "constant dissatisfaction, similar to the transient annoyance which a normal person has after attempting a sigh, but not quite attaining the complete expansion desired."

During the Second World War, a special Effort Syndrome Unit

was in operation in London, and its director published 20 characteristic signs of this syndrome, which should have clarifed to his colleagues the nature of this still-continuing problem. The chemical nature of the symptoms was clarified in one subject, when, unknown to the patient, carbon dioxide was added to the patient's air supply. This, of course, restored the normal level of carbon dioxide in the patient's body, which was followed by the disappearance of symptoms. This same phenomenon may be responsible for some of the improvement seen with carbon dioxide inhalation therapy, which was introduced into psychiatry by Von Meduna.

Hyperventilation causes a change in the pattern of the electrocardiogram, the abnormality being related to the alkaline condition of the blood. The diagnostic confusion that can arise during an attack of hyperventilation when the patient arrives in the emergency room and has both chest pains and EKG changes is obvious.

Spirograms of patient's breathing patterns show the most abnormal patterns in patients with anxiety neurosis; less abnormal patterns in patients diagnosed as hysteric; and normal patterns for schizophrenic patients. One observer noted that many patients feel relieved by manual pressure exerted by the doctor upon the patient's thorax, and also noted that sometimes children, "thinking tears were warranted, but finding they were not quite spontaneous, facilitate crying by taking a few deep breaths." Many patients diagnosed as hyperventilation syndrome had had a recent death in the family, which, of course, would produce a variety of emotional symptoms, including, perhaps, unexpressed grief, since wailing is not encouraged in our stiff-upper-lip society.

In another study of psychosomatic responses to stress, the cardiorespiratory derangement caused by receipt of the hospital bill was greater than that caused by the illness itself.

It is estimated that 11 percent of all the patients in a large internal medicine practice were most accurately diagnosed as hyperventilation syndrome. Three different types of chest pain were common: (a) a sharp knife-like pain over the left chest, (b) a dull, persistent gnawing ache, often associated with tender chest muscles, and, (c) a heavy, pressing sensation under the breastbone.

Patients with restless, sighing breathing, are usually those who are desperate but are actively seeking a solution, while patients with quiet breathing and decreased excursion of the chest are those who

have given up trying to change their life situation. It should be noted that hyperventilation can also be caused by a wide variety of "real" physical illnesses, such as fever, drug intoxication, distended bladder, heatstroke, brain tumor, and parathyroid disease.

The most prolific student of the hyperventilation syndrome, B. I. Lewis, found it especially helpful during the hyperventilation test to push on the lower portion of the patient's chest with his palm to encourage greater thoraxic excursion. In nearly all of his patients who developed hyperventilation symptoms with this test, there was a marked emotional catharsis, with weeping and revelation of important historical material. The relevance of this observation, published 25 years ago, is obvious to students of the various contemporary body therapies.

In summary, hyperventilation is a condition of overbreathing, usually unknown to the patient, which seems to be precipitated by a wide variety of stresses operating upon susceptible individuals with the net result being a respiratory alkalosis, decreased cerebral oxygen and function, and a wide variety of mental and physical symptoms.

Hypoventilation is closely connected with Ondine's Curse. Ondine, during one of her many adventures, offended one of the Immortals, and was cursed with the necessity of needing to think about every vital function. Thus, if she fell asleep, her breathing would cease, and death would ensue; thus, she was sentenced to eternal and unpleasant wakefulness.

In the last 15 years, important discoveries have been made, relevant to patients who forget to breathe. This was first noted in studying a variety of patients referred with a complaint of unrestful sleep. When carefully watched, these patients, usually heavy snorers, would stop breathing entirely during sleep. After a period of one to several minutes, the patient, half-suffocated, would struggle awake, take a few deep breaths and fall back to sleep again, only to repeat this pattern thoughout the night. Families reported the patients to be very restless sleepers because of this noisy struggle.

Intensive study of this problem has suggested two major types of causation: (a) disturbances in central nervous system physiology, which interrupts normal control of ventilation, and (b) obstructive phenomena of the upper airway, such as the syndrome of decreased muscle tone in the tongue during sleep, which causes the tongue to fall backwards, occluding the throat. Further study has indicated

that the conditions may be genetic. One family studied had a father with restless sleeping, nighttime periods of absent breathing and fatigue during the day. He had two sons with severe disturbances of sleep, and breathing, another son who died suddenly in his sleep, and a young grandson who died during his sleep for no known cause.

It is interesting to note that unlike the extensive literature that exists concerning the psychological conditions resulting from hyperventilation, there is virtually nothing written in the psychiatric research literature concerning hypoventilation. One can easily speculate that surely there is a relationship between chronic underbreathing and, for example, depressive states, lack of energy and a diminishing of self-worth, but this avenue has not been pursued. This is perhaps a manifestation of the current trend of talking about stress, overactivity, and hypertension while neglecting their counterparts such as flaccidity, diminished movement and lack of tone. There has been a good deal of work done, of course, in the areas of exercise and sports medicine, to say nothing of the researches of various body therapy approaches, but the insights gained there have not been translated in the psychiatric and medical journals into considerations of mental health and the living of daily life.

The further study of hyperventilation and hypoventilation would be best promoted by techniques that combine clinical observation, such as occurs during a psychotherapy session, with some of the standard, and highly accurate, techniques for measuring oxygen and carbon dioxide levels. It is my belief that such studies will clarify the nature of our transactions with our patients, whatever the label given to that type of therapy, and give us some better understanding of the effect of breathing upon our daily functioning.

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